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(54) **Composite for plastic liquid crystal display**

Schichtstruktur für Plastik-Flüssigkristallanzeige

Stratifié pour dispositif d'affichage en plastique à cristal liquide

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## Description

[0001] This invention relates to composites useful for forming a liquid crystal display, and to methods for forming such composites.

[0002] Liquid crystal displays (LCDs) are used extensively in watches, calculators, radios, laptop computers and, more recently, in flat screen and projection television systems.

[0003] In a typical arrangement, a LCD is formed by placing two glass plates very close to one another so that a small gap is formed between the plates. Each glass plate has a polarizing film on its outer surface. A transparent electrical conductor is deposited on the inner surface of each glass plate. In a passively addressed display, the transparent conductor is patterned into a series of mutually perpendicular lines, i.e., row and column electrodes. The row and column electrodes define a plurality of cells.

[0004] The gap between the plates is filled with a liquid crystal polymer material. The liquid crystal polymer material, typically a cyanobiphenyl, has the ability to rotate the direction of polarized light. Polarization direction follows the physical rotation of the liquid crystal molecules, i.e., the direction of the long axis of the molecules.

[0005] Typically, a liquid crystal material is used which forms loosely organized chains that rotate from one side of the gap to the other side. As such chains rotate or "twist," so do the axes of the individual liquid crystal molecules. Light, which is polarized as it passes through the entrance polarizer, has its polarization direction rotated following the physical rotation of the liquid crystal polymer molecules as the light passes through the cell. In a typical arrangement, the polarizer on the exit side of the display passes light that has had its polarization direction rotated in the manner described. Viewed from the exit side, such a cell is clear, or transmitting.

[0006] The alignment of the liquid crystal molecules, and, hence, the polarization direction of light passing through the liquid crystal, can be changed by applying an external electric field.

Applying a voltage across the cell gap by addressing the appropriate line on each side of the cell causes the chains of liquid crystal molecules to align themselves with the applied electric field, "untwisting" as they align. Since the polarization direction of light passing through such "untwisted" liquid crystal polymer is not rotated, such light is blocked from exiting the cell by the exit polarizer, which passes only rotated light.

Such a cell appears dark from the exit side. When the voltage is turned off, the liquid crystal returns to its original state, and the pixel is clear again. See generally, O'Mara W., "Liquid Crystal Flat Panel Displays - Manufacturing Science and Technology", Van Nostrand Reinhold (1993).

[0007] In typical prior art methods for manufacturing LCDs, each of the two glass plates are processed separately. The processing of each plate includes the deposition of various layers, device patterning and other techniques. After each plate is processed, it is mated with its complement and liquid crystal material is injected into the gap between the plates. In recent advances, some manufacturers are replacing the glass plates with plastic.

[0008] There are a number of drawbacks to such prior art manufacturing methods. Processing the plates separately is time consuming or, alternatively, expensive if another processing line is added to process plates in parallel. Further, each of the complementary plates may experience different processing conditions resulting in errors when registering the plates. And, the alignment process itself is susceptible to error. Processing is further complicated by the use of plastic materials. Such plastics are typically very thin, light, flexible and generally troublesome to handle without damage. Furthermore, typical alignment systems are optical in nature and developed for use with rigid materials.

[0009] US-A-4 228 574 does neither use a "reversibly" bonded substrate, nor a "layer" as stated in the characterising portion of Claim 1, but it contains a prior disclosure of a composite which includes all the other features of Claim 1. JP-A-56 140322 does not use a "reversibly" bonding step as stated in the characterising portion of Claim 5, but it contains a prior disclosure of a method of forming another composite for forming a liquid crystal display which includes all the other steps of Claim 5.

[0010] According to one aspect of this invention there is provided a composite as claimed in claim 1.

[0011] According to another aspect of this invention there is provided a method as claimed in claim 5.

[0012] A method and composite for doubled-sided processing of plastic substrates that can be used as the plates in a liquid crystal display is disclosed. According to one embodiment of the invention, an ultraviolet light (UV) blocking layer is sandwiched between two plastic substrates. A layer of indium-tin-oxide (ITO) is disposed on one side of each of the two plastic substrates. The plastic substrates are arranged so that the ITO layer on each substrate faces outward. The resulting composite sandwich structure is laminated and can be rolled-up or sheared into individual sheets for further processing.

[0013] If the substrate is sheared into individual sheets, the electrodes can be formed in a manner similar to inner-layer processing in the printed circuit board industry. Thus, existing facilities can be used for processing.

[0014] In the double-sided processing of the present invention, circuitry can be photoimaged on the bottom and top plastic substrates simultaneously. Mechanical registration features are placed into both substrates after photoimaging so that there is minimal loss of registration in subsequent cell assembly steps. The sandwich structure can be separated any time after the mechanical registration features are added.

**Brief Description of the Drawings**

**[0015]** Further features of the invention will become apparent from the following detailed description of specific embodiments thereof when read in conjunction with.the accompanying drawings in which like elements have like reference numbers and in which:

FIG. 1 is a cross-sectional view of a composite embodying the present invention wherein two suitably-treated plastic substrates are temporarily attached to a UV-blocking substrate;
FIG. 2 is a perspective view of an arrangement for forming the composite of FIG. 1;
FIG. 3 is a flow diagram illustrating an embodiment of a method for forming the composite of FIGS. 1 and 2;
FIG. 4 is a flow diagram illustrating a method for forming the electrodes;
FIG. 5 illustrates steps pertaining to registration and alignment for forming a liquid crystal display; and
FIGS. 6 & 7 illustrate steps pertaining to joining complementary plates in a process for forming a liquid crystal display.

**Detailed Description of the Invention**

**[0016]** Referring to FIG. 1, one embodiment of a composite 1 includes an ultraviolet light (UV)-blocking layer 7 sandwiched between an upper plastic substrate 3a and a lower plastic substrate 3b. The outer surfaces 4 of the upper and lower plastic substrates 3a, 3b are coated with layers 5a and 5b, respectively, of transparent electrode material. In a preferred embodiment, thin protective layers 9a, 9b are placed over the electrode layers 5a, 5b, respectively, to insure that the electrode layers are not damaged during handling.

**[0017]** The plastic substrates 3a, 3b should have a high glass transition temperature and, for twisted nematic (TN) liquid crystal polymer material, should have low birefringence. Further, the plastic substrates 3a, 3b should be clear, i.e, water-white. Suitable plastics include, without limitation, polyethylene terephthalate and polyethersulfone. Preferably, the plastic substrates have a thickness of about 4 to 7 mils, but could be of any suitable thickness.

**[0018]** The transparent electrode layers 5a, 5b are preferably indium-tin-oxide (ITO) or ITO combined with other materials, such as gold, to improve conductivity. The layers 5a, 5b are preferably about 700 to 2000 angstroms thick. The layers 5a, 5b are typically sputter deposited onto the plastic substrate. The sputtering process is controlled so that the layers 5a, 5b are transparent, easily patterned and have a resistivity appropriate for the display application. The deposition of ITO by sputtering and other methods is well known to those skilled in the art. See, O'Mara W., "Liquid Crystal Flat Panel Displays - Manufacturing Science and Technology", Van Nostrand Reinhold (1993) at pp 114-117. This reference, and all other references mentioned in this specification are incorporated herein by reference in their entirety.

**[0019]** In a preferred embodiment, the UV-blocking layer 7 can be any material that is flexible, punchable and suitable for blocking ultraviolet light. Preferably, the UV-blocking layer 7 should have an optical density of 3 or greater at wavelengths of 400 nanometers (nm) and less. To achieve or promote flexibility, the UV-blocking layer 7 is preferably about 1 to 10 mils in thickness. Flexibility is required for "reel-to-reel" processing applications wherein, after formation, the composite 1 is wound about a roller, as discussed below. If the composite is sheared into individual sheets, the UV-blocking layer 7 can be rigid and thicker.

**[0020]** Suitable materials for the UV-blocking layer include, without limitation metal or paper. Plastic can also be used for the UV-blocking layer, provided that the plastic adsorbs light in the appropriate range of wavelengths. In particular, the plastic should absorb light at the wavelength or wavelengths at which the photoresist (which is used to pattern the transparent electrode layers 5a, 5b as described below) is sensitive; typically about 400 nm or less. Certain plastics, by virtue of their structure, absorb light at the appropriate wavelength. Nylon is one such example. Other suitable plastics will be known to those skilled in the art.

**[0021]** Furthermore, most plastics can be modified, by incorporating additives, to absorb light in the aforementioned range of wavelengths. For example, polyethylene terephthalate can be filled with carbon black so that it absorbs light having a wavelength of 400 nm or less. Such a modified polyethylene terephthalate is suitable for the UV-blocking layer 7.

**[0022]** In a further embodiment of the present invention, the composite comprises two substrates 3a, 3b, which, in addition to possessing the properties previously described for the substrates, further absorb light at the appropriate wavelengths as described above. In such an embodiment, the composite comprises two substrates and no discreet UV-blocking layer 7. Neither nylon nor carbon black filled-polyethylene terephthalate will be appropriate for this embodiment since such materials are not suitably transparent. An example of a plastic suitable for this embodiment is an appropriate grade of an imidized acrylate. Imidized acrylates are available from AtoHass of Philadelphia, Pennsylvania under the trademark KAMAX™. Other suitable plastics will be known to those skilled in the art. Furthermore, an appropriate amount of benzotriazole derivatives can be used as a non-yellowing additive for plastics to cause them to absorb light in the range of 400 nm or less. Other additives suitable for such a purpose are known to those skilled in the art. Selecting an appropriate grade of plastic, or determining an appropriate amount of additive, as described above, is within the capabilities of one skilled in the art.

[0023] The protective layers 9a, 9b are preferably about 1 mil in thickness and formed of polyethylene terephthalate or like plastics.

[0024] FIG. 2 is an exemplary embodiment of an arrangement suitable for forming the composite 1. Preferably, the various materials forming the composite 1 are wound on rollers, such as rollers 8a - 8c, and fed to a means for pressing the materials together, such as laminating rollers 11. In a preferred embodiment, the edges 15 of the composite are sealed after lamination using plastic welding methods such as ultrasonic bonding and the like. If the material is sheared into sheets, such as the sheet 21, the cut edges are preferably likewise sealed. Thus, equipment, not shown, for sealing the composite is preferably located near the laminating rollers 11 and the cutter 13. Because the sheets are sealed on all four sides, the composite is held together by vacuum until such time as separation is required.

[0025] In a further embodiment, rather than welding the edges of the composite, an adhesive 19 may be disposed on the outer edges 17 of the inner surface 2 of the upper or lower plastic substrates 3a, 3b to form a bond to maintain the various layers of the composite in abutting relation. Alternatively, the adhesive 19 may be disposed on the outer edges of-both surfaces of the UV-blocking layer 7.

[0026] In a further embodiment, a weak adhesive may be applied over larger portions of both surfaces of the UV-blocking layer 7 so that the upper and lower substrates 3a, 3b can be temporarily bonded to the UV-blocking layer across the full width of the substrates rather than at the edges only. In this alternate embodiment, it is important that a weak adhesive is used since the upper and lower substrates 3a, 3b of the composite 1 must be separated from one another in subsequent processing steps. The protective layers 9a, 9b, if present, need not be welded or glued to each other or the preceding substrate layers 3a, 3b since such layers are removed well before the rest of the composite is separated and will remain abutted to the substrate layers via a static attraction.

[0027] It is preferable to use a plastic welding method or an adhesive, in conjunction with laminating rollers 11, to bond the various layers together. In other less preferred embodiments, the composite 1 can be bonded using laminating rollers or other devices for pressing the layers together, alone. In such embodiments, the pressing or lamination step should be performed at a temperature at which the UV-blocking layer 7 or substrate layers 3a, 3b will soften. Alternatively, a coating layer, selected for its ability to soften at the lamination temperature, can be added to the UV-blocking layer 7 or substrate layers 3a, 3b.

[0028] After bonding, the composite 1 may be rolled-up around a roller, not shown, or sheared into individual sheets through the use of a cutter or shearer 13. The composite 1, either rolled or sheared, is then ready for further processing. If the composite 1 is sheared, it is preferably sheared into sheets having dimensions typically suitable for wiring board manufacture, such as 18 inches (in.) x 24 in. or 24 in. x 24 in.

[0029] A first embodiment of a method of the present invention is illustrated in FIG. 3. In step 100, two plastic substrates, such as the plastic substrates 3a, 3b, that have been coated on one side with a transparent electrode material, such as the transparent electrode material 5a, 5b, are suitably positioned for further processing. The present method may include the step of coating the substrates 3a, 3b with transparent electrode material, however, it is presently preferred to have the substrates 3a, 3b precoated by a facility specializing in such operations. Further, a material suitable for blocking ultraviolet light, such as the UV-blocking layer 7, is positioned so that it will be sandwiched between the substrates 3a and 3b as the composite is formed.

[0030] If an adhesive is applied as a step in the present method, it can be applied in step 105. Such adhesive may be applied as described above or in any other manner suitable for bonding the composite as will occur to those skilled in the art in view of the present teachings. In an alternate embodiment, adhesive may be pre-applied by the supplier of the UV-blocking layer 7 or the substrates. If the composite is sheared into sheets, it is preferable to supplement the adhesive bond to the edges 15 of the composite with a further bond to each sheared end. This can be accomplished in step 120, described below.

[0031] In step 110, the composite 1 is formed by sandwiching the UV-blocking layer 7 between the two plastic substrates 3a, 3b and passing them through the laminating rollers 11 or other means for pressing the various layers together. The plastic substrates 3a, 3b are positioned so that the surface 2 of each of the substrates is proximal to the UV-blocking layer 7. Thus, the transparent electrode material 5a, 5b faces outwardly relative to the UV-blocking layer 7.

[0032] In an alternate embodiment, the composite formed in step 110 further comprises protective layers, such as the protective layers 9a, 9b, as shown in FIG. 2, for example. In this embodiment, the two substrates 3a, 3b and the UV-blocking layer 7 are sandwiched between the protective layers 9a, 9b.

[0033] In step 120, the composite is bonded/sealed to keep the various layers of the composite in proper abutting relation. Bonding can be accomplished by the ultrasonic bonding method mentioned above or by other plastic welding methods known to those skilled in the art. As such, equipment suitable for plastic welding may be positioned to weld the composite as it emerges from the laminating rollers 11 and after the cutter 13, if present. As previously noted, if an adhesive is used as in step 105, or pre-applied by a supplier, bonding is accomplished in step 110 as the various layers are drawn through the laminating rollers 11 or like device. It is desirable, however, to supplement the aforementioned adhesive bond by bonding the sheared edges of the com-

posite (if the composite is to be sheared into sheets) using plastic welding methods. Further, as previously described, "bonding" can take place in step 110 if lamination is performed at suitable temperature such that the various layers soften.

[0034] As described above, once the composite 1 is formed, it may be rolled-up or sheared for further processing. Such further processing, which is described in more detail below, includes patterning the electrodes, as illustrated in FIG. 4, and punching registration holes, depositing the alignment layers and separating the composite, which are illustrated in FIG. 5. Additional processing is required to form the liquid crystal display. Such additional processing, which is illustrated in FIGS. 6 and 7, is well known in the art and will not be discussed in detail.

[0035] Substantial changes occur to the substrates 3a, 3b as they are processed to become the "plates" of the LCD such that it would not be inappropriate to refer to them by a descriptor other than "substrate". For clarity, however, the term "substrate" will be used in this specification regardless of the extent to which the substrates 3a, 3b have been processed, i.e., photolithographic processing, deposition of further layers, etc. Returning to FIG. 4, the protective layers 9a, 9b, if present, are stripped in step 140.

Photoresist is then applied to the layers of transparent electrode material 5a, 5b on each of the plastic substrates 3a, 3b in step 150. In step 160, the art work or masks for patterning the transparent electrode material into stripes, lines or rectangular plates are placed in registration with each of the upper and lower plastic substrates 3a, 3b and then exposed with UV light. Since the composite 1 incorporates the UV-blocking layer 7, the mask attached to the upper plastic substrate 3a and the mask attached to the lower plastic substrate 3b can be exposed simultaneously. Mechanical registration features, such as holes, may be punched into the plastic substrates 3a, 3b any time after exposure. The use of plastic for the LCD plates, rather than glass, facilitates incorporation of mechanical registration features.

[0036] In step 170, typical photolithographic processing steps such as development, etching, stripping, drying and the like are performed.

[0037] It is preferable to pattern the electrode material using photolithographic methods as discussed above and as illustrated in FIG. 4. Screen or offset printing methods, however, can likewise be used to pattern the electrode material. Such printing methods are well known to those skilled in the art. If screen or offset printing methods are used, the UV-blocking layer 7 is not required. Throughout this specification, the word "pattern," as used in the context of patterning the electrode material, refers to either photolithographic or printing methods. As shown in Figures 4-7, electrodes are patterned at a plurality of discrete regions on a sheet of the composite 1, such as the sheet 21 shown in FIG. 2. Each of such regions will eventually be cut and trimmed to form one of the plates of an LCD. A number of such plates are thus formed on a single sheet of the composite. It should therefore be appreciated that while the description will generally refer to the formation of a single LCD from sheets of the substrates 3a, 3b, a plurality of such LCDs are typically formed.

[0038] As previously noted, registration features, such as holes, can be punched in the composite 1 at any time after exposure of the photoresist. This procedure is indicated in step 180 of FIG. 5.

[0039] In step 190, a thin polymer film referred to as an alignment layer or orientation film is deposited on the transparent electrode layer 5a, 5b, which has since been patterned. The alignment layer facilitates orientation of the liquid crystal molecules at the surface of the plastic substrate. Suitable polymer materials and methods for depositing such polymers are well known to those skilled in the art.

[0040] In step 200, the bonded edges of the composite 1 are trimmed so that the plastic substrates 3a, 3b can be separated from one another, delaminating the composite.

[0041] While it is preferable to deposit the alignment layer prior to delaminating the composite 1, the deposition described in step 190 can be performed after delamination.

[0042] After separation, the alignment layer on each of the plastic substrates 3a, 3b is rubbed in a chosen direction, as illustrated in step 210 of FIG. 6. Rubbing leaves fine grooves in the surface of the alignment layer that aid in aligning the liquid crystal molecules at the plastic substrate surface, and also promotes a proper "tilt" angle. Methods for rubbing and control of tilt angle through rubbing pressure and speed are known to those skilled in the art. Rubbing and other processing steps that will be mentioned below are known in the art and are typically employed in forming LCDs.

[0043] After rubbing, the plastic substrates 3a, 3b are cleaned and dried, and then, in step 220, connector windows are punched through one of the plastic substrates. In steps 230 and 240, edge seal is applied and spacers are deposited on one of the plastic substrates to allow a precise gap between the upper and lower plastic substrate 3a, 3b to be formed and maintained. As shown in step 250, the upper and lower plastic substrates are then brought together and aligned. Alignment is accomplished using a mechanical alignment system and the registration features. For more critical applications, an optical alignment system can also be used. As shown in step 260 of FIG. 7, the edge seal that was applied in step 230 can be either UV- or thermally-cured. Liquid crystal material is injected between the laminated plastic substrates in step 270. To allow for injection, the plastic substrates comprising the plurality of "plates" is typically cut to provide rows or columns of such plates with one cut edge. In the final step 280, a polarizer is applied to the outside of each plastic substrate.

[0044] It should be understood that the embodiments

described in this specification are illustrative of the principles of the present invention and are not intended limit the scope of the invention.

## Claims

1. A composite (1) useful for forming a liquid crystal display, comprising:

   a first substrate (3a) having a first surface and a second surface, said first surface of said first substrate having a transparent electrode material (5a) disposed thereon;
   a second substrate (3b) having a first surface and a second surface, said first surface of said second substrate having a transparent electrode material (5b) disposed thereon, **characterised in that** said second substrate is reversibly bonded to said first substrate; and **in that** said composite further comprises

      a layer (7) for blocking ultraviolet light, wherein said layer is disposed between and abutting said second surface of said first substrate and said second surface of said second substrate.

2. The composite of claim 1 comprising a protective layer, for example polyethlene terephthalate, abutting the transparent electrode material.

3. The composite of claim 1 wherein the first and second substrate is a plastic selected from the group consisting of polyethylene terephthalate and polyethersulfone, and/or the transparent electrode material is selected from the group consisting of indium-tin-oxide and an alloy of indium-tin-oxide and gold, and/or the layer suitable for blocking ultravoilet light is selected from the group consisting of plastic, metal and paper.

4. The composite of claim 1, wherein at least the first substrate is either an imidized acrylate having an optical density of 3 or greater at at least one wavelength in the range of 400 nanometers (nm) and less, or a plastic containing a suitable amount of benzotriazole derivative so that the substrate has an optical density of 3 or greater at at least one wavelength in the range of 400 nanometers (nm) and less, and/or the transparent electrode material is patterned into an electrode by photolithography requiring the deposition of photoresist, wherein at least the first substrate is a plastic having an optical density of 3 or greater at the wavelength or wavelengths of light at which the photoresist is sensitive.

5. A method of forming a composite (1) suitable for forming a liquid crystal display comprising the steps of:

   providing a first and a second substrate (3a, 3b) having a first and a second surface, each substrate having a transparent electrode material disposed on the first surface thereof;
   providing a layer (7) suitable for blocking ultravoilet light, said layer having a first and a second surface;
   positioning the layer suitable for blocking ultravoilet light between the second surfaces of the first and the second substrate, **characterized by** reversibly bonding the first substrate, the layer suitable for blocking ultravoilet light and the second substrate, together, forming a composite.

6. The method of claim 5 wherein the step of bonding comprises:

   (a) applying an adhesive to the second surface of at least the first substrate or to the first and second surface of the layer suitable for blocking ultravoilet light; and
   (b) pressing the first substrate, the layer suitable for blocking ultravoilet light and the second substrate, together; or
   (c) pressing the first substrate, the layer suitable for blocking ultravoilet light and the second substrate, together; and
   (d) welding together the edges of the first and second substrate and the layer suitable for blocking ultravoilet light; or disposing adhesive on at least one of the said substrates.

7. The method of claim 6 wherein the step of applying the adhesive comprises applying adhesive to both side edges either of the second surface of at least the first substrate, or of the first and second surface of the layer suitable for blocking ultravoilet light.

8. The method of claim 5, wherein the step of providing a layer suitable for blocking ultravoilet light further comprises providing said layer wherein an adhesive has been disposed on both the first and second surface of the layer.

9. The method of claim 5, comprising cutting the composite to form sheets of a predetermined length, or, providing a first and second layer protection layer suitable for protecting the transparent electrode material; and

   positioning the substrates and the ultravoilet light blocking layer between the first and second protection layer.

**Revendications**

1. Composite (1) utile pour former un dispositif d'affichage à cristaux liquides, comprenant :

   un premier substrat (3a) ayant une première surface et une seconde surface, ladite première surface dudit premier substrat ayant un matériau d'électrode transparent (5a) disposé sur elle ;
   un second substrat (3b) ayant une première surface et une seconde surface, ladite première surface dudit second substrat ayant un matériau d'électrode transparent (5b) disposé sur elle ;

   **caractérisé en ce que**
   ledit second substrat est lié de manière réversible audit premier substrat ;
   et **en ce que** ledit composite comprend en outre une couche (7) pour bloquer la lumière ultraviolette, ladite couche étant disposée entre et contre ladite seconde surface dudit premier substrat et ladite seconde surface dudit second substrat.

2. Composite selon la revendication 1 comprenant une couche protectrice, par exemple du téréphtalate de polyéthylène, contre le matériau d'électrode transparent.

3. Composite selon la revendication 1, dans lequel le premier et le second substrats sont un plastique sélectionné dans le groupe comprenant le téréphtalate de polyéthylène et le polyéther sulfone, et/ou le matériau d'électrode transparent est sélectionné dans le groupe comprenant l'oxyde d'indium-étain et un alliage d'oxyde d'indium-étain et d'or, et/ou la couche appropriée pour bloquer la lumière ultraviolette est sélectionnée dans le groupe comprenant du plastique, du métal et du papier.

4. Composite selon la revendication 1, dans lequel au moins le premier substrat est soit un imide-acrylate imide ayant une densité optique de 3 ou plus pour au moins une longueur d'onde dans la plage de 400 nanomètres (nm) et moins, soit un plastique contenant une quantité appropriée de dérivé de benzotriazole de sorte que le substrat a une densité optique de 3 ou plus pour au moins une longueur d'onde dans la plage de 400 nanomètres (nm) et moins, et/ou le matériau d'électrode transparent est modelé en électrode par photolithographie nécessitant le dépôt d'une photoréserve, dans lequel au moins le premier substrat est un plastique ayant une densité optique de 3 ou plus pour la longueur d'onde ou les longueurs d'onde de la lumière auxquelles la photoréserve est sensible.

5. Procédé pour former un composite (1) approprié pour former un dispositif d'affichage à cristaux liquides comprenant les étapes de :

   fourniture d'un premier et d'un second substrats (3a, 3b) ayant une première et une seconde surfaces, chaque substrat ayant un matériau d'électrode transparent disposé sur sa première surface ;
   fourniture d'une couche (7) appropriée pour bloquer la lumière ultraviolette, ladite couche ayant une première et une seconde surfaces ;
   positionnement de la couche appropriée pour bloquer la lumière ultraviolette entre les secondes surfaces du premier et du second substrats,

   **caractérisé par** la liaison réversible du premier substrat, de la couche appropriée pour bloquer la lumière ultraviolette et du second substrat ensemble, pour former un composite.

6. Procédé selon la revendication 5 dans lequel l'étape de liaison comprend :

   (a) l'application d'un adhésif sur la seconde surface au moins du premier substrat ou sur la première et la seconde surfaces de la couche appropriée pour bloquer la lumière ultraviolette ; et
   (b) le pressage ensemble du premier substrat, de la couche appropriée pour bloquer la lumière ultraviolette et du second substrat ; ou
   (c) le pressage ensemble du premier substrat, de la couche appropriée pour bloquer la lumière ultraviolette et du second substrat ; et
   (d) le soudage ensemble des bords du premier et du second substrats et de la couche appropriée pour bloquer la lumière ultraviolette ; ou l'application d'adhésif sur au moins un desdits substrats.

7. Procédé selon la revendication 6 dans lequel l'étape d'application de l'adhésif comprend l'application d'adhésif sur les deux bords latéraux soit de la seconde surface au moins du premier substrat, soit de la première et de la seconde surfaces de la couche appropriée pour bloquer la lumière ultraviolette.

8. Procédé selon la revendication 5 dans lequel l'étape de fourniture d'une couche appropriée pour bloquer la lumière ultraviolette comprend en outre la fourniture de ladite couche, un adhésif ayant été appliqué à la fois sur la première et sur la seconde surfaces de la couche.

9. Procédé selon la revendication 5 comprenant la découpe du composite pour former des feuilles de lon-

gueur prédéterminée, ou la fourniture d'une première et d'une seconde couches de protection appropriées pour protéger le matériau d'électrode transparent ; et
le positionnement des substrats et de la couche bloquant la lumière ultraviolette entre la première et la seconde couches de protection.

**Patentansprüche**

1. Schichtstruktur (1), die zur Bildung einer Flüssigkristallanzeige nützlich ist, umfassend:

   ein erstes Trägermaterial (3a), das eine erste Oberfläche und eine zweite Oberfläche aufweist, wobei die erste Oberfläche des ersten Trägermaterials ein darauf aufgetragenes transparentes Elektrodenmaterial (5a) aufweist;

   ein zweites Trägermaterial (3b), das eine erste Oberfläche und eine zweite Oberfläche aufweist, wobei die erste Oberfläche des zweiten Trägermaterials ein darauf aufgetragenes transparentes Elektrodenmaterial (5b) aufweist, **dadurch gekennzeichnet, dass** das zweite Trägermaterial reversibel mit dem ersten Trägermaterial verbunden ist und dadurch, dass die Schichtstruktur weiter

   eine Schicht (7) zum Blockieren von ultraviolettem Licht umfasst, wobei sich diese Schicht zwischen der zweiten Oberfläche des ersten Trägermaterials und der zweiten Oberfläche des zweiten Trägermaterials befindet und an diesen anliegt.

2. Schichtstruktur nach Anspruch 1, die eine Schutzschicht umfasst, beispielsweise Polyethylenterephthalat, die am transparenten Elektrodenmaterial anliegt.

3. Schichtstruktur nach Anspruch 1, wobei das erste und das zweite Trägermaterial ein Plastikmaterial ist, das aus einer Gruppe gewählt ist, die Polyethylenterephthalat und Polyethersulfon umfasst, und/oder das transparente Elektrodenmaterial aus einer Gruppe gewählt ist, die Indiumzinnoxid und eine Legierung aus Indiumzinnoxid und Gold umfasst, und/oder die Schicht, die geeignet ist, ultraviolettes Licht zu blockieren, aus einer Gruppe gewählt ist, die Plastikmaterial, Metall und Papier umfasst.

4. Schichtstruktur nach Anspruch 1, wobei mindestens das erste Trägermaterial entweder ein imidiertes Acrylat ist, das bei mindestens einer Wellenlänge im Bereich von 400 Nanometern (nm) oder weniger eine optische Dichte von 3 oder mehr aufweist, oder ein Plastikmaterial, das eine geeignete Menge eines Benzotriazol-Derivats umfasst, so dass das Trägermaterial bei mindestens einer Wellenlänge im Bereich von 400 Nanometern (nm) oder weniger eine optische Dichte von 3 oder mehr aufweist, und/oder das transparente Elektrodenmaterial durch Fotolithografie, die die Ablagerung eines Fotoresists erfordert, zu einer Elektrode gerastert ist, wobei mindestens das erste Trägermaterial ein Plastikmaterial ist, das bei der Wellenlänge oder Wellenlängen von Licht, bei dem der Fotoresist empfindlich ist, eine optische Dichte von 3 oder mehr aufweist.

5. Verfahren zur Bildung einer Schichtstruktur (1), die geeignet ist, eine Flüssigkristallanzeige zu bilden, das die folgenden Schritte umfasst:

   Bereitstellen eines ersten und zweiten Trägermaterials (3a, 3b), die erste und zweite Oberflächen aufweisen, wobei auf die jeweils erste Oberfläche von jedem Trägermaterial ein transparentes Elektrodenmaterial aufgetragen ist;

   Bereitstellen einer Schicht (7), die geeignet ist, ultraviolettes Licht zu blockieren, wobei diese Schicht eine erste und eine zweite Oberfläche aufweist;

   Positionieren der Blockierschicht für ultraviolettes Licht zwischen den zweiten Oberflächen des ersten und des zweiten Trägermaterials, **dadurch gekennzeichnet, dass** das erste Trägermaterial, die mit der Blockierschicht für ultraviolettes Licht und das zweite Trägermaterial reversibel verbunden sind und diese zusammen eine Schichtstruktur bilden.

6. Verfahren nach Anspruch 5, wobei der Schritt des Verbindens umfasst:

   (a) Auftragen eines Klebstoffs auf die zweite Oberfläche mindestens des ersten Trägermaterials oder auf die erste und zweite Oberfläche der Blockierschicht für ultraviolettes Licht; und
   (b) Zusammendrücken des ersten Trägermaterials, der Blockierschicht für ultraviolettes Licht und des zweiten Trägermaterials; oder
   (c) Zusammendrücken des ersten Trägermaterials, der Blockierschicht für ultraviolettes Licht und des zweiten Trägermaterials; und
   (d) Zusammenschweißen der Kanten des ersten und zweiten Trägermaterials und der Blockierschicht für ultraviolettes Licht; oder Auftragen von Klebstoff auf mindestens eines dieser Trägermaterialien.

7. Verfahren nach Anspruch 6, wobei der Schritt des Klebstoffauftragens umfasst, dass Klebstoff auf beide Seitenkanten entweder der zweiten Oberfläche mindestens des ersten Trägermaterials oder der ersten und zweiten Oberfläche der Blockierschicht für ultraviolettes Licht aufgebracht wird.

8. Verfahren nach Anspruch 5, wobei der Schritt des Bereitstellens einer Blockierschicht für ultraviolettes Licht weiter umfasst, dass diese Schicht so vorgesehen ist, dass ein Klebstoff auf sowohl die erste und die zweite Oberfläche der Schicht aufgebracht ist.

9. Verfahren nach Anspruch 5, das Folgendes umfasst:

   Ausschneiden der Schichtstruktur, um Blätter einer vorbestimmten Länge zu bilden, oder Bereitstellen einer ersten und zweiten Schutzschicht, die das transparente Elektrodenmaterial schützten können; und

   Positionieren der Trägermaterialien und der Blockierschicht für ultraviolettes Licht zwischen der ersten und der zweiten Schutzschicht.

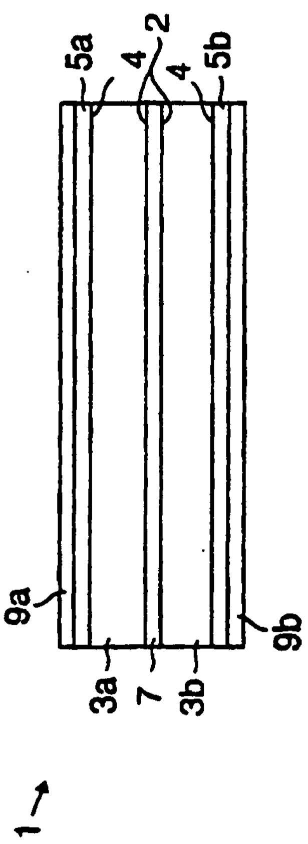
1
9a
3a
7
3b
9b
5a
4
2
4
5b

FIG. 1

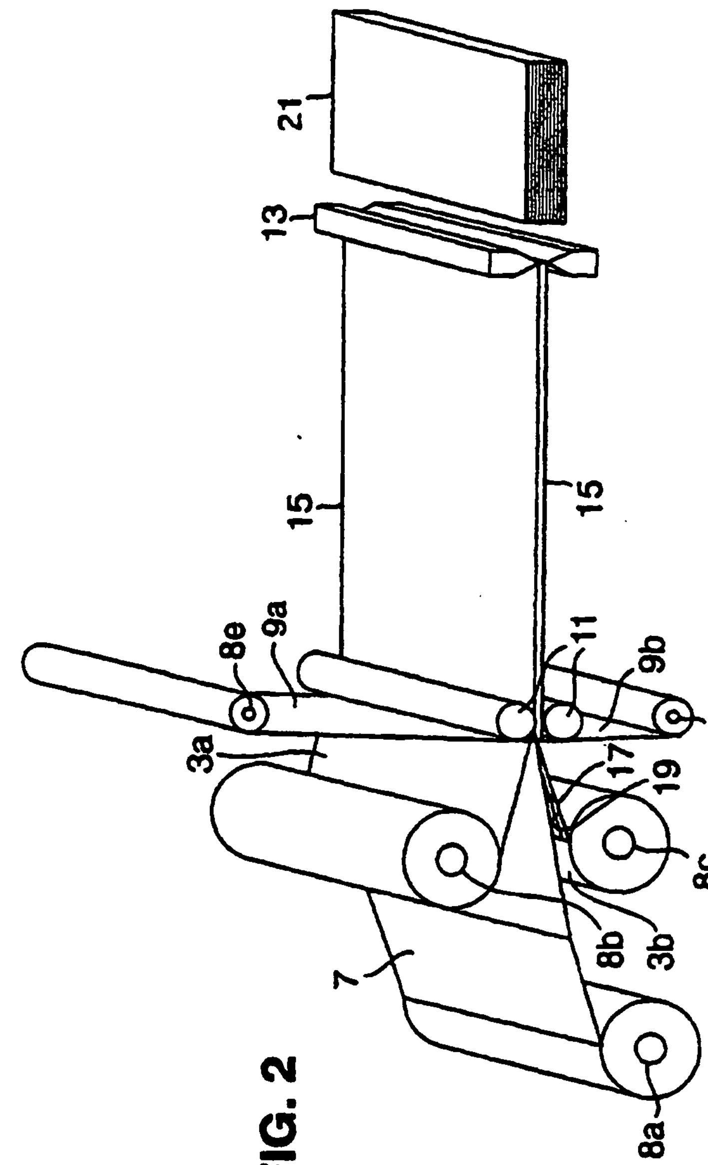
21
13
15
15
8e
9a
11
9b
3a
8d
17
19
8c
8b
3b
7
8a

FIG. 2

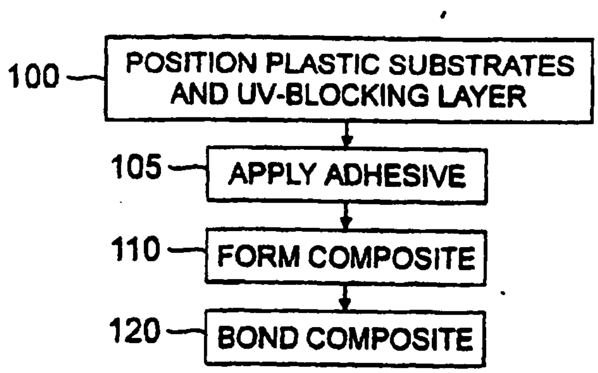
100
POSITION PLASTIC SUBSTRATES AND UV-BLOCKING LAYER
105
APPLY ADHESIVE
110
FORM COMPOSITE
120
BOND COMPOSITE

FIG. 3

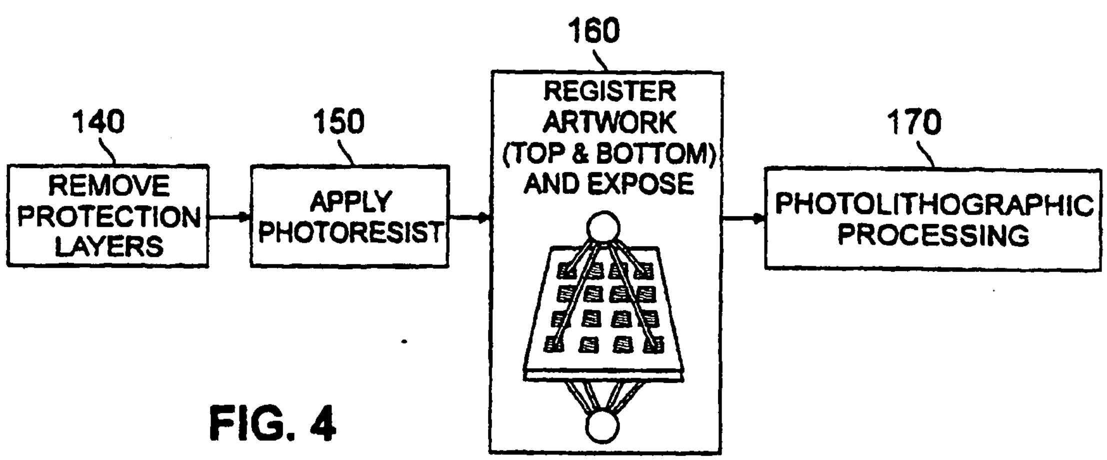
140
REMOVE PROTECTION LAYERS
150
APPLY PHOTORESIST
160
REGISTER ARTWORK (TOP & BOTTOM) AND EXPOSE
170
PHOTOLITHOGRAPHIC PROCESSING

FIG. 4

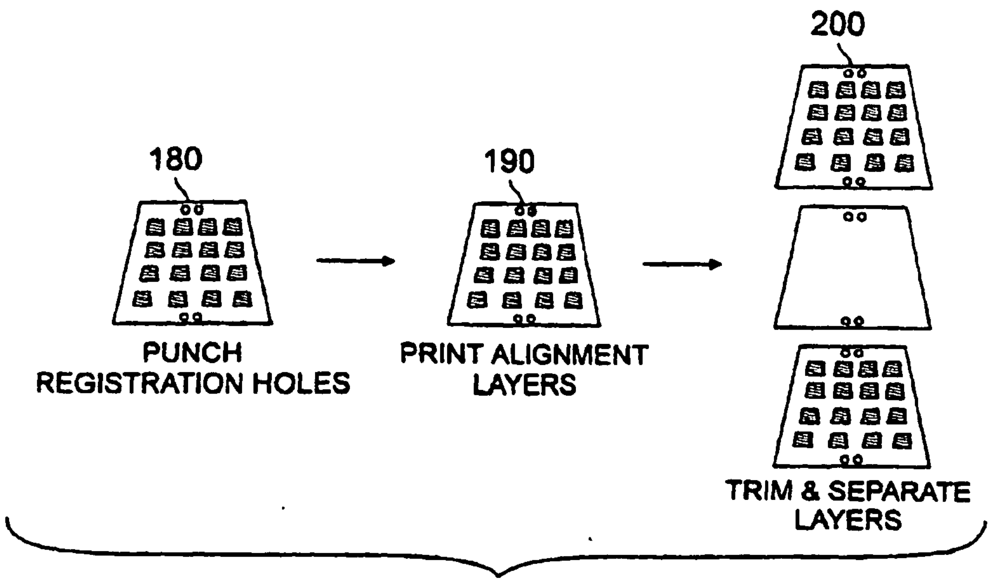


FIG. 5

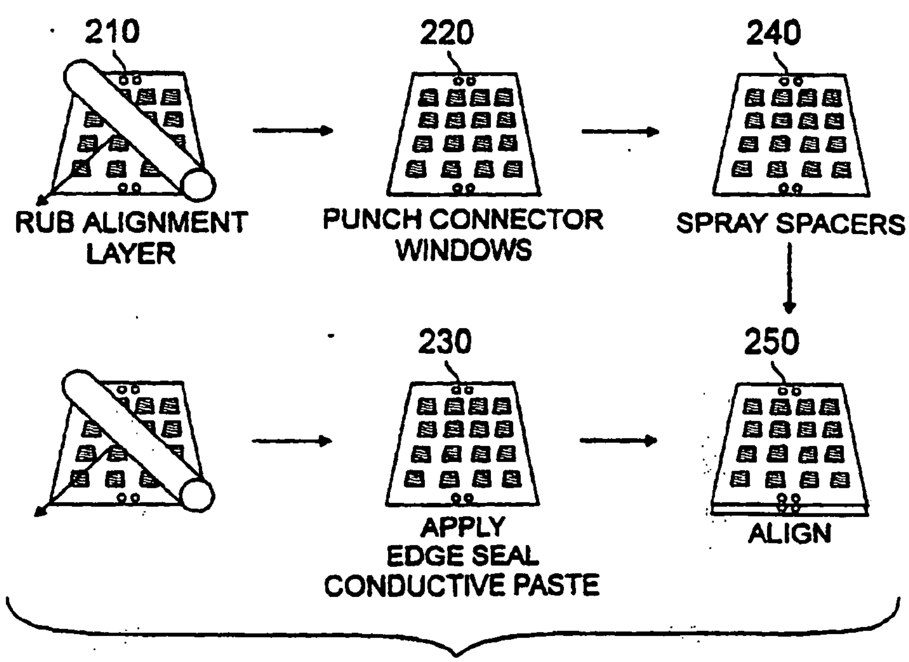


FIG. 6
PRIOR ART

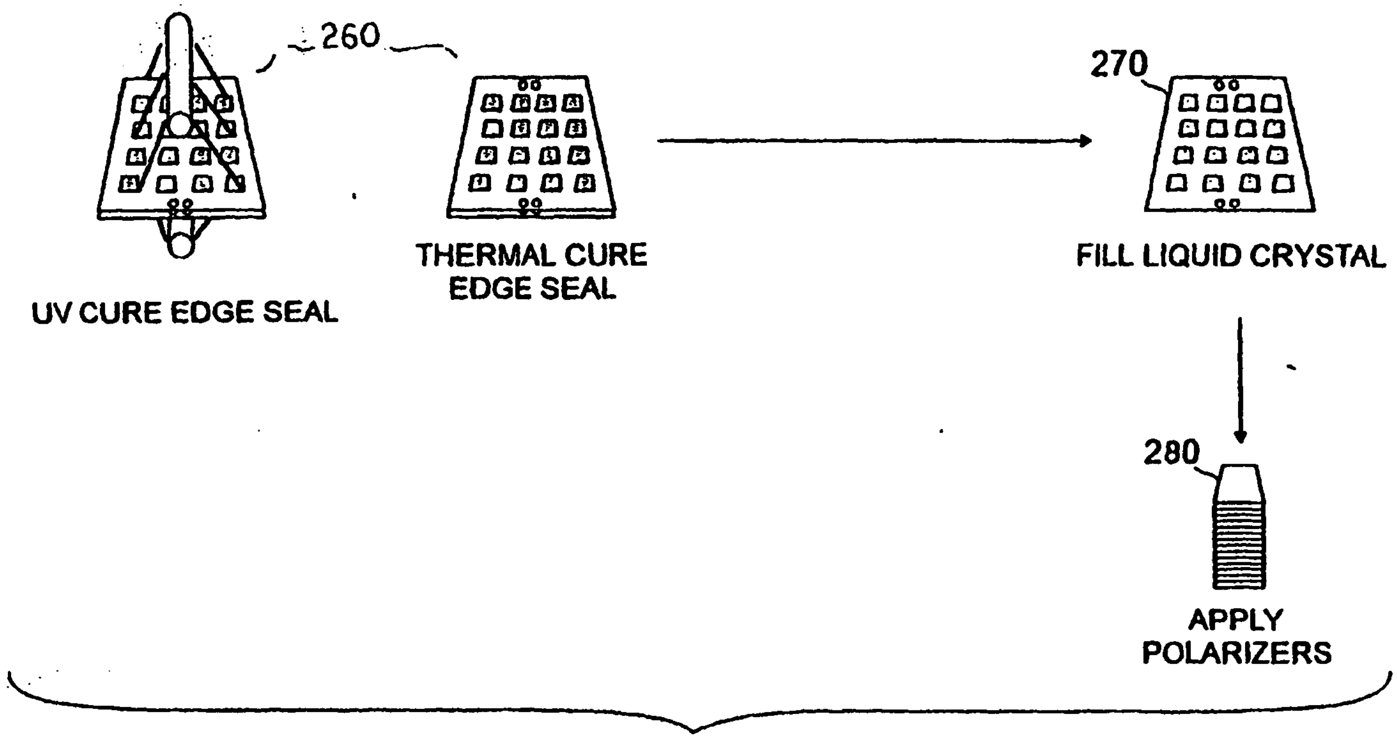


FIG. 7
PRIOR ART